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# Feeling the Heat: The Health Effects of Hot Days Vary across the Globe

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Scientists have linked heat waves to adverse health effects and premature deaths.[1] Most studies of heat waves and health have been conducted in a single city or region, but associations between heat waves and health can vary between locations.[2] A new study in *Environmental Health Perspectives* is the first to compare the effect of heat waves on mortality across the globe.[3]

There is no one way to define a heat wave; various studies have used different temperature thresholds over different lengths of time.[3] That variation creates a big challenge when comparing the findings from previous studies of the effects of heat waves on health, says lead study author Yuming Guo, an associate professor of environmental epidemiology and biostatistics at Monash University in Melbourne, Australia.

In their new study, Guo and colleagues analyzed daily data for weather conditions and what they termed nonaccidental/all-cause deaths reported in 400 different communities in 18 countries. The specific causes of death included in the analysis varied somewhat among the different countries. In one country, all deaths were included, whereas deaths were limited to those from nonaccidental causes in seven countries. In 10 other countries, deaths were limited to deaths from nonexternal causes, which excludes not only accidental deaths in particular, but also deaths that were unrelated to factors outside the body, such as suicide, drowning, or assault.

Each country had collected data over different timespans, sometimes over more than two decades. To account for different regional norms in temperature, the researchers defined heat waves based on percentiles (90th, 92.5th, 95th, or 97.5th) of average daily temperatures for each community. To examine how the length of a heat wave may have affected mortality, they looked at abnormally high temperatures lasting at least 2 days, at least 3 days, or at least 4 days. For instance, one theoretical heat wave modeled in the analysis was defined as 3 consecutive days with an average daily temperature in the top 10% of all average daily temperatures for that community.

Overall, the researchers estimated that heat waves by any definition were associated with a significant increase in deaths across each country. Heat waves involving higher temperatures were generally associated with greater increases in mortality risk. In contrast with previous research,[4] however, the researchers found that the number of days that a heat wave persisted did not modify the heat wave–related mortality risk.

Estimates of heat wave effects varied widely from city to city. For instance, a 2-day heat wave at the 95th percentile of average

The definition of "heat wave" can vary widely, depending on how hot the days are and how long the episode lasts. A new study found that heat waves by any definition were associated with a significant increase in deaths. Image: © Stefano Guidi/Shutterstock.

daily temperature was associated with a more-than-doubled risk of death from a nonexternal cause in Falesti, Moldova. In contrast, Phetchabun, Thailand, saw a slight decrease in nonaccidental mortality during heat waves of the same duration and intensity. Guo explains that this difference might be a result of personal strategies to keep cool, borne of adaptation to frequent hot weather.

In general, significant increases in mortality began on the first day of a heat wave and typically lasted 3–4 days after the culmination of the event—even longer in some countries. For instance, people may have had a heart attack during a heat wave but died several days later. Although high temperatures can trigger immediate deaths from causes such as cardiovascular disease, they may also lead to subtle alterations in bodily functions such as increased blood pressure or heart rate, which could compound existing health problems, explains Guo.

The researchers concluded that the increases in deaths could be attributed largely to daily high temperatures. Guo says these findings suggest that reducing health risks associated with hot days may be better achieved using high-temperature warning systems, which are based solely on temperature, as opposed to heat wave warning systems, which can vary depending on how "heat wave" is defined.

Brooke Anderson, an assistant professor of environmental epidemiology at Colorado State University, calls the new findings novel. "Knowing that some of the health effects for heat waves persist after the initial event has very important implications for public health," she says. Such information could help communities make decisions about how long to keep cooling centers open or whether to perform door-to-door checks on vulnerable individuals, says Anderson, who was not involved in the study.

Countries including Italy, Moldova, and Vietnam saw the largest increases in deaths associated with heat waves. The researchers are not sure why some countries experienced greater mortality risk during hot weather than others experienced. The researchers surmise that low rates of air conditioning use in Italy and Moldova and low levels of socioeconomic development in Moldova and Vietnam could be important reasons, although they did not investigate community-level factors that could account for differences in mortality risk.

"Future studies could dig into important factors that may be driving lower or higher mortality risk in different cities," says Anderson. Some of these factors could include large populations of sick or elderly people, community preparedness measures, cultural habits, lifestyle patterns (for instance, whether the population typically spends more time indoors or outdoors), and housing types.

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